Original Article

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Clinical Profile and Visual Outcome of Traumatic Glaucoma Patients Following Closed Globe Injury in the Rural Part of Eastern Uttar Pradesh at a Tertiary Eye Care Centre: A Retrospective Cohort Study

Ophthalmology Section

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ABSTRACT

Introduction: Glaucoma is a significant cause of ocular morbidity following ocular trauma, particularly Closed Globe Injury (CGI), which frequently leads to elevated Intraocular Pressure (IOP). This type of trauma can result in various tissue damages such as radial sphincter tears, iridodialysis, angle recession, cyclodialysis, trabecular meshwork tears, zonule separation, or peripheral retinal dialysis. Damage in these areas can lead to early or delayed onset glaucoma.

Aim: To evaluate the clinical profile, assess visual outcomes, and analyse management strategies in post-traumatic glaucoma with CGI.

Materials and Methods: The retrospective cohort study was conducted at a tertiary eye care centre in Department of Ophthalmology, Regional Institute of Ophthalmology (RIO), Sitapur, Uttar Pradesh, India. from January 2020 to December 2022. Retrospective data of patients presenting with CGI and developing elevated IOP (>21 mmHg) were collected. Only patients with a minimum follow-up of three months were included. Various parameters, including demographics, IOP, Best-Corrected Visual Acuity (BCVA), and the effects of medical and surgical treatments on IOP and BCVA, were analysed. The Ocular Trauma Score (OTS) was also calculated. Statistical analysis was performed using Microsoft excel and Statistical Package for Social Sciences software version 21.0, with a significance level of 5%. Continuous variables were described as mean±Standard Deviation (SD), and an unpaired t-test was used for comparisons between pre- and postmanagement visual acuity and IOP.

Results: Out of 259 eyes with ocular trauma, 93 (35.90%) were diagnosed with CGI and developed elevated IOP. The most common causes of elevated IOP were hyphema (37.63%) and angle recession mechanisms (32.25%). The median IOP at presentation was 35 mmHg (range: 12 to 71 mmHg) and decreased to 16.5 mmHg (range: 4 to 52 mmHg) at the last follow-up (p-value <0.001). Surgical management was required in 30 (32.25%) eyes, with 13 (13.97%) eyes undergoing trabeculectomy.

Conclusion: Post-traumatic IOP elevation occurred in 93 (35.90%) eyes with CGI, and 13.97% of these eyes required glaucoma filtering surgery for IOP control. Overall, medical management was necessary in 67.74% of eyes, while 32.25% required surgical intervention. Eyes with posterior segment involvement had poor visual acuity. Poor baseline vision and vitreo-retinal involvement increased the risk of a poor visual outcome.

Keywords: Angle recession, Hyphema, Ocularttrauma score, Post-traumatic glaucoma, Trabeculectomy

INTRODUCTION

Post-traumatic glaucoma is primarily caused by injuries to the anterior segment, with blunt trauma to the eyeball being the most common form of injury [1]. Ocular blunt trauma refers to Closed Globe Injuries (CGI), where mechanical deformation or direct energy delivery leads to ocular damage [1]. Ocular trauma is a preventable public health issue worldwide, contributing significantly to ophthalmic morbidity and monocular blindness [2]. The global annual incidence of ocular trauma is approximately 55 million cases, with around 750,000 cases requiring hospitalisation each year [3]. These injuries can occur in various settings, including recreational and sports-related activities, workplaces, homes, assaults, agricultural accidents, and road traffic accidents [4]. In India, the reported incidence of ocular trauma varies from 1% to 5%.

The impact of blunt injury results in a sudden compressive deformation of the eye, with the cornea and anterior sclera displaced posteriorly and compensatory expansion of the globe in the equatorial direction [5,6]. Campbell DG described seven rings or circles of tissue anterior to the equator of the globe that expand suddenly upon blunt impact [7]. Due to the inability of the internal fluids of the eye to compress, the forces are transmitted to these seven rings of tissue. This often leads to tissue splitting or tearing, resulting in various manifestations such as radial sphincter tears, iridodialysis, angle recession, cyclodialysis, trabecular meshwork tears, zonule separation, or peripheral retinal dialysis. Damage in these areas can lead to early or delayed onset glaucoma [8].

Following ocular blunt trauma, early onset glaucoma may be caused by contusion injury, intraocular inflammation, trabecular meshwork damage, traumatic hyphema, while late-onset glaucoma may be attributed to angle recession, lens-induced glaucoma, ghost cell glaucoma, closure of cyclodialysis cleft, peripheral anterior synechiae, epithelial downgrowth, retained intraocular foreign body, choroidal haemorrhage, and rhegmatogenous retinal detachment [8]. In addition to evident ocular damage, blunt trauma can result in long-term effects such as traumatic cataract and angle recession glaucoma, which can significantly impact prognosis and necessitate vigilant long-term follow-up. Proper assessment of ocular damage and prompt treatment after an injury have a crucial impact on the final outcome of the eye.

Therefore, early diagnosis and appropriate treatment are essential to prevent visual morbidity caused by ocular trauma. The present retrospective study aimed to evaluate the clinical profile, assess visual outcomes, and analyse management strategies in post-traumatic glaucoma with CGI.

MATERIALS AND METHODS

The present retrospective cohort study was conducted at the Department of Ophthalmology, Regional Institute of Ophthalmology (RIO), Sitapur, Uttar Pradesh, India. The study included patients with traumatic glaucoma following CGI who presented between January 2020 and December 2022. The study was approved by the Institutional Review Board of the parent Institution (No.EC/OA/12/2019) and adhered to the principles of the Declaration of Helsinki. Informed consent was obtained from all patients before proceeding with treatment options.

Inclusion criteria: The patients of age between 5 and 75 years, eyes with an initial or subsequent follow-up IOP above 21 mmHg, eyes with a history of at least three months of Antiglaucoma Medications (AGM) instillation, and eyes requiring surgical intervention for IOP control were included.

Exclusion criteria: The patients with a history of glaucoma or prior use of AGM and follow-up duration of less than three months were excluded.

Study Procedure

The initial assessment also included evaluating injury to other organs, loss of consciousness, and previous ocular surgical history. The examination began with a comprehensive evaluation of the face, orbital area, eyelids, and eyeball. Visual acuity was measured using Snellen's equivalent and converted to the Logarithm of the Minimum Angle of Resolution (logMAR) for statistical analysis. This was followed by slit lamp biomicroscopy for anterior segment examination, posterior segment evaluation using +78D/+90D lens, and examination of the peripheral retina with indirect ophthalmoscopy using a +20D lens. Angle structures were evaluated using a four-mirror gonioscope. Closed globe trauma was classified according to the standardised international classification of ocular trauma as closed globe subgroups, including contusion (no full-thickness injury) and lamellar laceration (partial thickness injury) [9,10].

Clinical parameters, including pre- and post-treatment BCVA, pre- and post-treatment IOP measured using applanation tonometry, slit lamp and gonioscopy findings, dilated fundus evaluation findings, and ultrasound (USG B-scan) findings when the posterior segment was not visible at presentation, were recorded. IOP measurement, gonioscopy, and USG B-scan were performed after ruling out globe rupture. All patients were initially started on topical antiglaucoma medications upon detection of elevated IOP and received additional treatment based on the nature of the injury. Regular follow-ups were conducted to assess visual outcomes and complications. Only data from eyes with a minimum follow-up of three months following the trauma were included in the analysis. Blood tests for diagnosing sickle cell disease or trait were performed in patients with hyphema. The Ocular Trauma Score (OTS) was calculated in three steps: Step 1 involved collecting the variables and their raw points, Step 2 entailed calculating the sum of the raw points, and Step 3 involved converting the raw points into the OTS and determining the likelihood of the final visual prognosis [11].

STATISTICAL ANALYSIS

All statistical analyses were performed using Microsoft excel and SPSS software version 21.0, with a significance level set at 5%. Continuous variables were presented as mean±standard deviation. An unpaired t-test was conducted to compare pre- and postmanagement visual acuity and IOP.

RESULTS

During the study period, a total of 259 eyes presented with ocular trauma, out of which 93 (35.90%) eyes sustained CGI and developed IOP above 21 mmHg. The age at presentation ranged from 6 to 75 years, with a median of 25 years and a mean (SD) of 27.32 (14.37) years. The majority of the eyes 31 (33.33%) belonged to the second decade of life (11-20 years). There was a male predominance, with 82 cases (88.17%) being male and a male to female ratio of 7.4:1. Forty-eight patients (51.61%) had injuries in their left eyes, while 45 (48.38%) had injuries in their right eyes. Only 11 eyes (11.82%) presented within 24 hours, 30 eyes (32.25%) within one week, and the remaining 52 eyes (55.91%) presented after one week [Table/Fig-1].

Variables	n (%)
Total injured eyes	93
Right/left eye	45 (48.38%)/48 (51.61%)
Male/female	82 (88.17%)/11 (11.83%)
Age (years)	
6-10	5 (5.37%)
11-20	31 (33.33%)
21-30	27 (29.03%)
31-40	15 (16.12%)
41-50	7 (7.52%)
51-60	5 (5.37%)
61-75	3 (3.22%)
Time interval from injury to presentation	
0-24 hours	11 (11.82%)
24 hours-1week	30 (32.25%)
After 1 week	52 (55.91%)
Causes of IOP elevation	
Hyphema	35 (37.63%)
Angle recession	30 (35.48%)
Lens induced	14 (15.05%)
Pigmentary	10 (8.60%)
With posterior segment involvement	4 (3.22%)
VA in Log MAR and OTS (mean±SD)	
VA at presentation	1.62±0.96
VA at two months	0.95±0.90
Raw score	79.12±11.99
OTS score	3.34±0.79

[Table/Fig-1]: Characteristics of patients with ocular trauma.

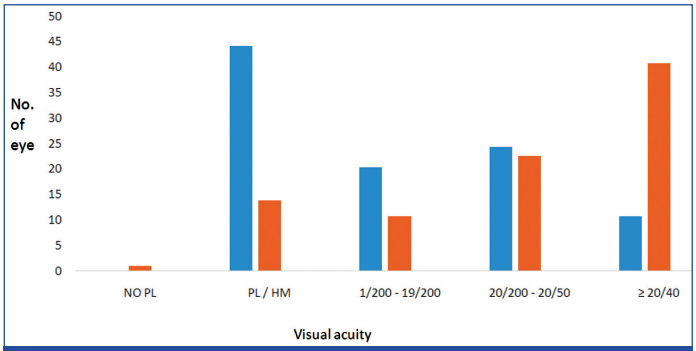
At presentation, 75 eyes (80.64%) had elevated IOP, while 12 eyes (12.90%) developed elevated IOP within one month of trauma, and 6 eyes (5.37%) developed elevated IOP after one month of trauma. The median IOP at presentation was 35 mmHg (range 12 to 71 mmHg) and reduced to 16.5 mmHg (range 4 to 52 mmHg) at the last follow-up ($p<0.001$). Hyphema was the most common cause of raised IOP (35, 37.63%), followed by angle recession (30, 32.25%). Ball (21, 22.58%), hand (21, 22.58%), and stick (20, 21.5%) were the leading causes of CGI.

During the course of follow-up, 14 eyes (15.05%) developed cataract, with 11 eyes requiring cataract extraction and intraocular lens implantation, and three eyes undergoing the Glaucoma triple procedure [Table/Fig-2]. The initial Visual Acuity (VA), measured in logMAR, was 1.62±0.96 (mean±SD), and after three months, it improved to 0.95±0.90. There was a significant difference between initial VA and final VA ($p<0.0001$) [Table/Fig-1]. Only 10 eyes (10.75%) had an initial VA of 20/40 or better, 23 eyes (24.73%) had an initial VA of 20/200–20/50, 19 eyes (20.43%) had an initial VA of 1/200-19/200, and 41 eyes (44.08%) had an initial VA of Light Perception/Hand Motion (LP/HM). No eye had an initial VA of NLP.

After approximately three months of follow-up, the final VA was 20/40 or better in 38 eyes (40.86%), 20/200–20/50 in 21 eyes (22.58%), and 1/200-19/200 in 10 eyes (10.75%). Thirteen eyes (13.97%) had a final VA of LP/HM, and one eye (1.07%) had a final VA of NLP [Table/Fig-3].

Surgical procedure	Number of eyes (%)
Anterior chamber wash	1 (1.07%)
Trabeculectomy with Mitomycin C (MMC)	9 (9.67%)
Cataract surgery with IOL implantation	11 (11.82%)
Anterior chamber wash + Trabeculectomy with MMC	1 (1.07%)
Cataract + IOL + Trabeculectomy with MMC (Glaucoma triple)	3 (3.22%)
Diode cyclophotocoagulation	1 (1.07%)
Laser peripheraiiridectomy	1 (1.07%)
Scleral buckling with post vitrectomy	1 (1.07%)
SFIOL + post vitrectomy	1 (1.07%)
Postvitrectomy + Endolaser for RH	1 (1.07%)

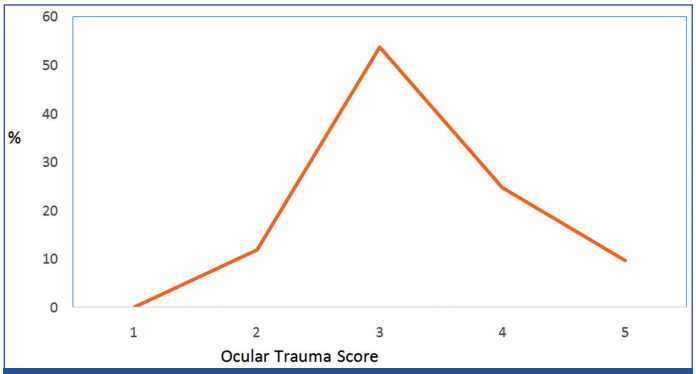
[Table/Fig-2]: Types of surgical procedures.



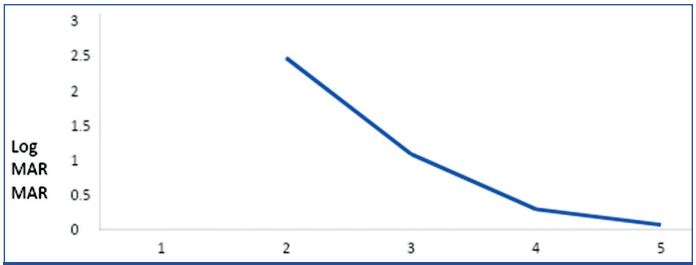
[Table/Fig-3]: Comparison of vision at presentation and at the end of 3 months. The blue bar represents vision at presentation, and the orange bar represents final visual acuity

Gonioscopy revealed angle recession in 30 eyes (35.48%), with all eyes developing angle-recession glaucoma having more than 180° angle recession. Examination in a dilated pupil showed posterior segment involvement in 4 eyes (4.30%), including vitreous haemorrhage, retinal hole, retinal detachment, and posteriorly dislocated crystalline lens. Out of these four eyes, one eye experienced spontaneous resolution of vitreous haemorrhage, while the other three required surgical intervention. Initially, 64 eyes (68.81%) were managed medically, while 30 eyes (32.25%) eventually required surgical intervention. Different types of surgical procedures were performed based on the individual cases.

In terms of the Ocular Trauma Score (OTS), 9 eyes (9.67%) had an OTS of 5, 23 eyes (24.73%) had an OTS of 4, 50 eyes (53.76%) had an OTS of 3, and 11 eyes (11.82%) had an OTS of 2 [Table/Fig-4]. No eye had an OTS of 1. The OTS showed high prognostic accuracy and could be used in counselling patients and making management decisions after injury. Mean visual acuity according to the OTS is shown in [Table/Fig-5].



[Table/Fig-4]: Distribution of OTS.



[Table/Fig-5]: Mean visual acuity according to OTS.

DISCUSSION

The aim of this study was to assess the clinical profile, visual outcomes, and management strategies in post-traumatic glaucoma with CGI in rural eastern Uttar Pradesh. The study revealed that out of the total patients, 63 (67.74%) were below the age of 30, with a male to female ratio of 7.4:1. A similar study conducted in Ethiopia reported that 194 (63.8%) patients were below 30 years of age, with a male to female ratio of 3.2:1 [12]. The higher prevalence of ocular trauma among males can be attributed to their tendency to choose hazardous jobs and engage in risk-taking outdoor activities, putting them at a greater risk of injury. In this study, patients primarily experienced ocular trauma related to outdoor activities and sports. The use of high-speed cricket balls, a popular sport among the young population in India, increased the odds of ocular trauma, leading to contusion, hyphema, and angle recession.

A recent study reported an incidence of 10 patients (18.4%) of angle recession following cricket ball injuries [13]. In this study, 31.6% of patients presented within 48 hours, while 28.6% arrived one week or later [12]. In the present study, projectiles such as cricket balls, wooden sticks, and hands accounted for 66.66% of injuries resulting in glaucoma, and only 11 (11.82%) patients presented within 24 hours. Delayed presentation may be attributed to poor access to healthcare services in rural areas, social and cultural beliefs prevalent among the rural population, as well as a lack of awareness regarding the importance of early diagnosis and prompt treatment of ocular injuries.

Studies by Kaur S et al., and Fung DS et al., have reported successful control of Intraocular Pressure (IOP) with medical management in 86.7% and 58.3% of cases, respectively [14,15]. In the present study, authors found that initially, medical management effectively controlled elevated IOP in 64 (68.81%) eyes with CGI, while 30 (32.25%) eventually required surgery to achieve IOP control. Additionally, 13 (13.97%) eyes underwent trabeculectomy. In a study involving adult eyes, Ozer PA et al., reported factors associated with the need for glaucoma surgery, such as hyphema, corneal injury, poor visual acuity, penetrating injuries, and optic atrophy [16].

In the present study, only 2 eyes (2.15%) with hyphema required drainage, while the rest could be managed medically. There was a remarkable improvement in visual acuity and IOP following management, with a p-value of <0.001. Regarding the Ocular Trauma Score (OTS), the study revealed a significant inverse relationship between OTS and vision at three months, as the OTS increased, vision, as measured by log MAR, decreased.

Limitation(s)

The main limitations of the present study were its retrospective nature, relatively small sample size, inability to perform serial fundus photographs and uniform visual testing due to patient cooperation issues. Despite these limitations, the data still provided valuable information regarding the clinical characteristics of ocular trauma.

CONCLUSION(S)

In conclusion, the present study found that young and middle-aged males engaged in hazardous occupations were at a higher risk of ocular trauma and associated morbidities. Glaucoma emerged as

a significant cause of ocular morbidity following trauma, with CGL being the primary cause of post-traumatic elevated IOP. Medical management successfully controlled IOP in approximately two-thirds of cases, while the remaining cases required surgery for IOP control. Initial visual acuity and the presence of co-existent vitreo-retinal injury were significant predictors of final visual acuity, and the OTS showed potential predictive value for final visual acuity in ocular trauma. Efforts should be made to educate the young and middle-aged working population about eye protection to prevent ocular trauma. Furthermore, establishing a nationwide collaborative registry of eye injuries in India could aid in research and prevention of eye injuries.

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